



BETTERBRICKS

# BUILDING COMMISSIONING

## for better public buildings

### CASE STUDY

## BELLEVUE COMMUNITY COLLEGE — NEW BUILDING SHOWCASES ENERGY EFFICIENCY



*South- and east-facing elevations*

*On the 3-story wing, light shelves shade the lower windows and reflect light to the ceilings through the upper windows. Below the courtyard is the ground-coupled bore field.*

In 2002, Bellevue Community College (BCC) celebrated the opening of a new energy-efficient classroom and office building—the R Building. The concrete frame and curtain wall structure features a three-story wing of classrooms and a dance studio, plus a two-story wing accommodating faculty offices, support and common areas. An open atrium joins the two wings.

BCC is currently the third largest higher education institution in Washington state, enrolling over 21,000 students per quarter. This newest building on campus features a ground-coupled hydronic heat pump system, and demonstrates state-of-the-art lighting and shading systems.

Just prior to construction, Bellevue Community College in conjunction with the Washington State Department of General Administration's building commissioning program hired Notkin Engineering of Seattle to commission the building's mechanical and electrical systems.

### COMMISSIONING QUICK FACTS

Building Name	"R" Building, Bellevue Community College
Location	Bellevue, Washington
Project	New L-shaped building (a 2-story wing and a 3-story wing, connected by an open atrium)
Commissioning Scope	HVAC-mechanical system; electrical building systems
Building Size	65,000 sq. ft.
Total Construction Cost	\$20,255,000
Total Commissioning Cost	\$89,200
Commissioning as % of Construction Cost	0.4%
Commissioning Cost per Square Foot	\$1.37
First-Year Cost Benefit	\$12,100
Annual Energy Savings	\$9,300 per year

## PROJECT PARTNERS

**Washington State  
Department of General  
Administration**  
Elizabeth Boggs Kittas, AIA

**Bellevue Community  
College**  
Donald L. Bloom

**Notkin Engineering**  
(Commissioning Agent)  
Craig Hawkins

**LMN Architects**  
Jane Hendricks

**M. A. Mortenson**  
(General Contractor)  
Dan Vo

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"Commissioning is an  
incredible tool that has  
proven its value ten-fold."

Donald L. Bloom  
Capital Projects Manager  
Bellevue Community College

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## PROJECT SCOPE OF WORK

A hydronic heating, ventilation, and air conditioning (HVAC) system serves the building from a closed-loop bore field. While the bore field was not part of the commissioning project, the following HVAC components were commissioned:

- Multiple water-source heat pumps
- Air-to-air heat exchangers
- Variable speed packaged pump system
- Direct digital controls (DDC)

Commissioning also included:

- Exhaust fans
- Plumbing fixtures and piping
- Sheet metal ducting
- Electrical panels, transformers, circuiting, grounding
- Data and communication cabling and wiring
- Lighting and lighting sensors

## ISSUES IDENTIFIED

Early in the process the commissioning agent reviewed contract documents, identifying several issues before they became construction problems. For example,

- Thermostat locations and some mechanical equipment not shown on floor plan drawings
- Discrepancies in voltages listed on the electrical drawings and those listed on mechanical equipment schedules
- Fire/smoke dampers shown on mechanical plans, but not circuited on the electrical plans

Functional testing began as equipment and systems came "on-line" and continued after the building was occupied. Among the deficiencies corrected were:

- Alarms not functioning properly on heat pump drain pan and on sump pump
- Hydronic system circuit setters clogged by debris from ground-coupled piping
- Programming errors in DDC system
- Amperages out of acceptable range for some circuit breakers
- Improper programming and calibration of the main electrical switchgears solid-state meter package
- Incorrect labeling of panel circuits, and broken circuit breaker handles
- Excessive shaft-to-ground voltages on three variable-frequency-driven motors

## ENERGY IMPLICATIONS OF COMMISSIONING

Some of the deficiencies found during functional testing will result in energy savings, including:

- Clogged circuit setters would have prevented proper hydronic water flow to the 54 heat pumps (causing them to run almost continuously) and would have impacted heat pump and heat recovery unit fans.
- Freeze-stats that were improperly installed would have caused the 7 heat recovery units to continue to run in low temperature conditions, eventually causing the coils to load with ice and causing fans to run continuously to satisfy the set points.
- Excessive ground-to-shaft voltages would have caused premature burnout of the three motors, disabling the variable frequency drive. This would have caused the remaining motors to run at the highest voltage available rather than the correct voltage as determined by the variable load.

## ADDITIONAL BENEFITS

In addition to energy cost benefits, other benefits that can be attributed to commissioning this project include:

- Found and resolved electrical code violations
- Prevented stress on motors from excessive ground-to-shaft voltages
- Documented and tracked deficiencies discovered during functional performance tests
- Reviewed operations and maintenance manuals—and witnessed training sessions—developed by installing contractors
- Found and resolved issues that would have plagued operations and maintenance staff



*Based on pump curves, the computerized pump set constantly optimizes operation of the 3 pumps*

## PROJECT BENEFITS

- \$12,100 in first-year cost benefits (such as fewer contractor call-backs, reduced change orders, problems corrected at design stage, etc.)
- \$9,300 in annual energy savings
- Potential construction problems avoided by reviewing contract documents early in the commissioning process
- Identified and corrected defects in equipment and installation

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"At first it seemed to be just another added hoop to jump through, but as the problems started to come out with the testing, it became obvious that commissioning was an added benefit to the job. By finding out and solving the problems before the warranty started, it has saved us countless hours and dollars in chasing nuisance complaints from the occupants."

Jeff White,  
Holmberg Mechanical  
(mechanical subcontractor)

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*Piping to and from the ground-coupled bore field.*

*With no boiler or cooling tower in the HVAC system, maintenance is very low.*

## WHAT IS COMMISSIONING?

Building commissioning is a systematic and documented process of ensuring that building systems perform according to the design intent and the owner's operational needs.

Commissioning is used in both new construction and existing buildings.

Commissioning:

- Provides a better environment for occupants
- Reduces indoor air quality problems
- Reduces occupant complaints
- Reduces contractor call-backs and warranty issues
- Reduces energy consumption and operational costs

## FOR INFORMATION ON WASHINGTON'S COMMISSIONING PROGRAM



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**BetterBricks**  
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